One Monetary Policy and Eighteen Central Bankers: The European Monetary Policy as a Game of Strategic Delegation

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Abstract

This paper employs a multi-country delegation model of a single monetary policy and argues that a decision making mechanism based on the median voter theorem is too restrictive for capturing important aspects of monetary policy in the European Monetary Union, particularly because intensity of preferences cannot play a role when only the median voter matters. Replacing the median voter mechanism by a less restrictive "weighted mean mechanism", it is shown that strategic delegation leads to a single monetary policy set in accordance with the preferences of the most inflation-averse member state. This finding provides theoretical support for "The Twin Sister Hypothesis" and the perception of the European Central Bank implementing the policy of the Bundesbank rather than the policy of an average union-wide central bank.

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1. Introduction

Within a multi-country, one-period strategic delegation framework, this paper offers further theoretical support for why the European Central Bank (ECB) might be the twin sister of the Bundesbank ("the twin sister hypothesis", Debrun 2001), i.e. why the monetary policy of the ECB mimics that of the Bundesbank rather than constituting an average of the optimal monetary policies of all the member states.

Meade and Sheets (2002) points to the importance of viewing the ECB Council as a group of delegates with conflicting interests. They find that the majority of ECB Council members typically voted on monetary policy changes in a manner that can be justified by the differential between their national inflation rate and the EMU average, thus suggesting that national interests or biases - of all 18 council members and not just the national central bank presidents – may play a role in deciding on the single monetary policy.[1]

Several papers have made contributions towards creating a better understanding of the single monetary policy and its implications. Debrun (2001) uses a two-country two-good model and a bargaining game to show why the ECB is minimizing a loss function biased towards German preferences, thereby supporting "the twin sister hypothesis". Aksoy, De Grauwe and Dewachter (2002) analyze the optimal policy setting rule under four decision scenarios (each characterizing whether the ECB Executive Board and/or the national central bank presidents have national or

[1] As pointed out by Dornbusch, Favero and Giavazzi (1998) "the issue is not that bank presidents take or solicit direct instructions from their patrons, but whether they are cloned and then sent on their

EMU-wide interests or whether policy is set in accordance with a European Monetary System-rule) and find that different member states have different views as to what is the optimal policy rule. Dixit (2000b) analyzes "lobbying" in the context of a two-country repeated game model of a monetary union, Sibert (1999) looks at reputation and voting, Dolado, Griffiths and Padilla (1994) analyze delegation in a two-country model without inflation bias and Waller (1992) uses a one-country bargaining model for investigating the appointment of central bankers in a two-party political system. In an important and early contribution, von Hagen and Süppel (1994) use a multi-country model with incomplete information to show that national interests can lead to inefficient choices.[2]

The delegation framework seems particularly well-suited for capturing the implications of a French delegate being French and a German delegate being German rather than both being merely Europeans.[3] Within such a framework, this paper points to the importance of how the decision making mechanism of the Council is modeled and argues that a mechanism based on the median voter theorem is overly restrictive, in particular because focusing on the median neglects the importance of the intensity of preferences. By replacing the median voter mechanism with a "weighted mean

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mission. When an issue of difference arises, a French appointee would vote in the style of France, and a German, as predictably, in the way of the Bundesbank."

[2] Cukierman and Lippi (1999) and Grüner (1999) focus on the wage-setting side and trade-unions internalizing the costs of inflation while Hughes-Hallett and Weymark (2002) consider asymmetries in transmission channels as well as differences in national preferences and the implications of constrained national fiscal policies. Papers by Laurelle and Widgren (1998), Napel and Widgren (2002), Widgren (1994) and (2001) study issues pertaining to voting, power distribution and fairness in the European Union.

[3] For early papers on the time-inconsistency problem of monetary policy see Kydland and Prescott (1977) and Calvo (1978).

mechanism", it is shown that strategic delegation may lead to the implementation of a European monetary policy set in accordance with the preferences of the most inflation-averse member state.

Under the premise that the optimal delegation decision depends on the decision making mechanism and the technicalities of the operational framework of the central bank, this result supports "the twin sister hypothesis" and may help explain why Germany was willing to join the EMU despite having already achieved credible commitment of monetary policy to an inflation-averse monetary authority.[4] The result is robust to non-simultaneous appointment choices and, therefore, the findings of the paper also indicate that unless the decision making process of the ECB Council is altered, enlargement of the EMU would not alter the monetary policy of the ECB.[5]

The rest of the paper is organized as follows: Section 2 sets up the multi-country version of the delegation model and characterizes the optimal single monetary policy from the perspective of the individual member state. Section 3 discusses the median voter theorem in the context of a central bank council, and introduces the less restrictive "weighted mean mechanism". Furthermore, the section

[4] Germany is typically perceived as the most inflation-averse of the EMU member states as well as the most influential. With respect to legal provisions and other institutional aspects, Buiter (1999) notes that the ECB closely resembles the Bundesbank in many ways and, therefore, the ECB will implement the policy of the Bundesbank. However, Wyplosz (1997) argues that non-German member states joined the EMU for the purpose of influencing the monetary policy of the ECB, thus suggesting that the ECB will implement the policy of an average union-wide central bank.

[5] Baldwin et al. (2000) and (2001) argue that enlargement of the EMU and thus the ECB Council under the prevailing rules will lead to decision making inefficiency and, therefore, reforming how the ECB's monetary policy decisions are made is a necessary prerequisite that must be in place prior to an enlargement.

describes the strategic delegation game, derives its unique equilibrium and analyzes the resulting single monetary policy. Section 4 discusses the robustness of the findings under various model alterations and extensions. Section 5 concludes.

2. The Model

The modeling framework is in the tradition of Barro and Gordon (1983) and Rogoff (1985).[6] Its a multi-country, one-period, delegation model with complete information in which the central bank council of the monetary union by deciding on whether to change interest rates (and by how much) sets inflation for all participating member states. For simplicity, inflation is the same across all member states.[7]

The model describes a monetary union with N member states. An essential feature of the model is that voters as well as delegates are "nationalistic" in the sense that they have country-specific rather than union-wide preferences, i.e. the median voter of member state j (and his delegate) is concerned with output in member state j instead of aggregated output of the N member states. This crucial assumption is in line with von Hagen and Süppel (1994) and incorporates the findings of Meade and Sheets (2002).

The preferences of the median voter in country j are given by

$$(1) \qquad L_j^V = E\frac{1}{2}\left[\lambda_j\left(y_j - \bar{y}_j\right)^2 + \left(\pi\right)^2\right],\ \bar{y}_j > 0,\ \lambda_j > 0,\ \text{j}=\{1,...,\text{N}\}$$

[6] At the cost of analytical simplicity, the results of the paper can also be derived in a new-Keynesian model (see, for example, Clarida, Gali and Gertler, 1999, for an exposition of such a framework).

where y_j is output in country j, $\bar{y}_j$ is the preferred value of output in country j, λ_j is the (constant) relative weight country j places on output objectives, and π is the rate of inflation.[8]

Conduct of the single monetary policy for the entire union is delegated to a politically independent council. Member state j chooses a council member delegate with preferences according to

$$(2) \qquad L_j^C = E\frac{1}{2}\left[\theta_j\left(y_j - \bar{y}_j\right)^2 + (\pi)^2\right],\ \bar{y}_j > 0,\ \theta_j > 0\text{, j=\{1,...,N\}}$$

where θ_j is the relative weight the council member from member state j places on output objectives.[9]

The council sets inflation for the entire union by changing the nominal interest rate. The interest rate change (the council's actual policy instrument) is linked to inflation in accordance with

$$(3) \qquad \pi = -\Delta i$$

where Δi is the change in nominal interest rates (between previous period and end-of-current period).[10] Since the previous period's interest rate is pre-determined, the policy instrument is simply the end-of-current period interest rate. This deterministic

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7 Grüner and Kiel (2001) study collective decision problems when agents hold private information about individually desired outcomes.

8 In order to conveniently facilitate the analysis of subsequent sections, it is assumed that no two countries have the exact same median voter preferences, i.e. $\lambda_j \neq \lambda_h$ for all $j \neq h$.

9 In the EMU, 6 member states have more than one delegate (due to the executive board). This is addressed in section 3 of the paper.

addition to the delegation model is in itself innocuous but has the advantage of allowing each member state's optimal inflation rate to be translated into an optimal interest rate change, thereby mimicking the reality of a council deciding on and announcing monetary policy through interest rate changes.[11]

Output in country j is described by a standard Lucas-supply function

(4) $$y_j = \pi - E[\pi] + u_j$$

where output is assumed to be a linear function of surprise inflation, (π- E[π]), and a mean-zero country-specific stochastic shock, u_j.[12]

The timing of the model is as follows. First, in each of the N member states, the median voter chooses a council member with preferences described by θ_j. Second, wages in each country are fixed simultaneously. Third, the council sets monetary policy for the union (i.e. the N delegates decide on Δi).

In order to characterize the optimal central bank policy (and thus the optimal council member if that council member were to single-handed decide on monetary policy for the entire union) from the perspective of member state j, the model is

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[10] Equation 3 is consistent with a basic (log-linear) money market equilibrium and relies on the same logic as a Taylor-rule (see, for example, Taylor 1993), stating that lower (higher) inflation is achieved through higher (lower) nominal interest rates.

[11] Since the delegates pay attention to their own preferences when jointly deciding on which common interest rate to set, it is not necessary to specify an aggregated loss function for the council.

[12] As usual, the underlying assumption is that all (nominal) wage contracts are pre-determined and, therefore, that the central bank can treat expected inflation, E[π], as given.

solved backwards, as usual.[13] In particular, the time-consistent interest rate change becomes:[14]

$$(5) \qquad \Delta i = -\theta_j \bar{y}_j + (\frac{\theta_j}{1+\theta_j}) u_j .$$

After taking expectations, the member state's expected loss as a function of the preferences of its delegate follows. Implicit differentiation of the expected loss with respect to θ_j yields the familiar first order condition for country j:

$$(6) \qquad -[\lambda_j \sigma_{u_j}{}^2] + [\sigma_{u_j}{}^2]\theta_j + [\bar{y}_j{}^2]\theta_j(\theta_j+1)^3 = 0$$

which characterizes the optimal council preferences from the viewpoint of the median voter in member state j. As in the standard one-country delegation framework, equation (6) solves for the optimal "Rogoff-central banker profile" for a member state with voter-preferences characterized by λ_j.[15]

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13 Derivations based on similar versions of the delegation model are shown in details elsewhere, see for example Alesina and Wacziarg (1999) and Alesina and Grilli (1992) for a multi-country delegation model where the central bank controls inflation directly and Walsh (1998), chapter 8, for a thorough exposition of the basic one-country delegation model where changes in money supply is the policy instrument of the central bank.

14 The steady state properties associated with equation (5) suggest that interest rates will eventually be driven to zero. By assuming that the most inflation-averse member state (and, therefore, this state's delegate) puts zero weight on output objectives and only cares about inflation, this can be avoided.

15 Restating the findings of Rogoff (1985), it is straightforward to prove that i) a unique, positive solution exists, ii) this solution corresponds to a loss function minimum, iii) the optimal θ_j is strictly smaller than λ_j and iv) the optimal θ_j is strictly increasing in λ_j such that the less weight-conservative a member state, the less weight-conservative its optimal council preferences. (Applying the terminology of Svensson (1997), the most weight-conservative member state is the member state whose preferences display the strongest inflation-aversion.) Furthermore, it is instructive to rewrite equation (6) as $\theta_j \bar{y}_j{}^2 - \frac{\sigma_{u_j}{}^2}{(\theta_j+1)^2}(\lambda_i - \theta_j) = 0$, showing that the median voter puts more weight

This unique solution maps into an optimal monetary policy choice given by the time-consistent interest rate change from equation (5).[16] From the properties of equation (6), it follows that the more weight-conservative the member state (the smaller the relative weight on output objectives in the loss function), the smaller the preferred interest rate change, ceteris paribus.

3. Monetary Policy in the European Monetary Union

3.1. The Median Voter Mechanism

Previous papers analyzing aspects of the single monetary policy within a N-country framework typically assume the prevailing decision-making mechanism to be based on majority voting and proceed by applying the median voter theorem.[17] Following this approach, the intensity of preferences does not matter for the median voter outcome and no member state has any incentive for misrepresentation by, say, choosing a delegate with a stronger inflation-aversion than what is dictated by equation (6). Furthermore, the optimal monetary policy choice is member state specific, no two member states have the exact same median voter preferences (by assumption), and the less weight-conservative a member state the larger the preferred

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on output objectives than does his optimal delegate and, not surprisingly, hat the optimal delegate puts more weight on output objectives, the larger the variance of the country-specific economic shock.

[16] The previous period's interest rate is assumed to be sufficiently high such that for no member state will the optimal interest rate change lead to a negative end-of-current period interest rate.

[17] This is the approach taken by Aksoy, De Grauwe and Dewachter (2002), Alesina and Grilli (1992), Alesina and Wacziarg (1999), Dixit (2000a), Grüner (1999) and von Hagen and Süppel (1994). Other

interest rate change. Then the policy outcome and its welfare implications are as follows: The council will consist of N relatively weight-conservative central bankers, i.e. each member state will choose a delegate with "Rogoff-central banker preferences", and the policy will be set by the median "Rogoff-central banker". Accordingly, $\frac{N-1}{2}$ member states would have preferred a more inflation averse policy (a higher end-of-current period interest rate, ceteris paribus) while other $\frac{N-1}{2}$ member states would have preferred a less inflation averse policy (a lower end-of-current period interest rate, ceteris paribus).[18]

Despite its convenience, the median voter theorem may not be well-suited for describing decision-making at a council such as the ECB Council. First, the protocol on the European System of Central Banks specifies that the vote cast by the ECB President is decisive in case of a tie, in which case, clearly, the President's vote carries more weight than any of the other 17 votes.[19] Second, and most importantly, modeling the decision making in such a way that any incentive for strategic

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papers simplify the issue of council board decision-making by reducing the number of member states to two, see Debrun (2001), Dixit (2000b) and Dolado, Griffiths and Padilla (1994).

[18] This finding replicates Alesina and Grilli (1992) and Alesina and Wacziarg (1999), and the reader is referred to these papers for a thorough discussion of country specific costs and benefits of participating in a monetary union, including aspects regarding whether a member state would be able to credibly delegate monetary policy to a politically independent central bank in the absence of a monetary union.

[19] See article 10, chapter 3, of the statute of the European System of Central Banks and the European Central Bank (protocol no. 3 of the Treaty on European Union, 1992) and Gros and Thygesen (1997) for a description of the ECB statutes. As a simple illustration, let N=4 and let the council members prefer interest rate increases of 0, 25, 50 and 75 basis-points, respectively. If the central bank president prefers the status quo, and his vote is decisive, the tie will lead to a zero interest rate change. Then the council member favoring a 50 basis-points change will have an incentive for misrepresenting his

delegation is ruled out a priori seems unappealing. Especially when the modeling framework itself relies on strategic delegation or "misrepresentation" and the notion of appointing a "Rogoff-central banker" (rather than letting the country's median voter conduct monetary policy) is in itself a matter of such strategic delegation.

3.2. The Weighted Mean Mechanism

In order to accommodate the suggested shortcomings of the median voter theorem and allow for strategic delegation within a decision making mechanism where the importance of a vote cast by member state j may carry a different weight than the vote cast by member state h (thereby also implicitly incorporating that a member state may have one or two votes), a less restrictive "weighted mean mechanism" is introduced.

Specifically, the council's decision making is described by:

$$\Delta i = \sum_{j=1}^{N} w_j \Delta i_j \tag{7}$$

where Δi characterizes the council's decision on monetary policy, w_j captures the voting weight (or influence) of member state j, and Δi_j is the monetary policy choice associated with member state j's delegate.[20, 21] The "weighted mean mechanism" may

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preferences by voting for a 25 basis-points change in order to improve on the outcome (and achieve a 25 basis-points increase rather than a zero interest rate change).

[20] Technically, the "weighted mean mechanism" shown in equation (7) is identical to the optimal interest rate rule labeled the "consensus rule" in Aksoy et. al. (2002). However, in this paper, the rule captures the council's decision making rather than the desired interest rate of the individual country.

[21] In the baseline model of this section, the voting weights are assumed to be constant. In order to prevent an extreme delegate from having the same influence as a more modest delegate, the next section introduces weights as decreasing functions of the deviation from the council member average,

describe a decision making based on either bargaining or voting - this appears to be a strength rather than a weakness, considering that minutes from the ECB Council meetings are unavailable and the ECB President states that monetary policy decisions are made without formal council voting.[22]

As in the one-country delegation model, the median voter in member state j is concerned with the policy outcome, whereas the preferences of his delegate are only a means to achieving this outcome. Therefore, it may well be in the interest of member state j to choose a delegate with preferences different from its respective "Rogoff-central banker" profile, for the purpose of "manipulating" the council towards, from the perspective of member state j, a more desirable policy outcome.

Since each member state is associated with a different and unique optimal monetary policy choice, Δi is replaced by $OPT\Delta i_j$, which characterizes the optimal policy choice from the perspective of the median voter in country j (which is, essentially, a country-specific constant and a direct mapping from the optimal "Rogoff central banker" preferences in the context of a one-country delegation

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thus ensuring that council members are not proposing unreasonable policies in order to "win" the decision making game.

[22] See, for example, ECB President Wim Duisenberg in response to a question from the press regarding the decision of the ECB Governing Council leading to an interest rate increase on February 3, 2000: "First, there was no formal vote. Again, as I had hoped and as it was, it was a consensus decision. Of course, we did discuss the size and the timing of the increase. There was no discussion of the direction. But, of course, we discussed the size and the timing. Well, with regard to the timing, the outcome of the discussion – by consensus – was that it was to be today, rather than later. And, with regard to the size, the outcome of the discussion – also by consensus – was that 1/4 percentage point, i.e. 25 basis points, was by far the preferable option."

model). Then equation (7) can be expressed as member state j's reaction function in its only choice variable $w_j \Delta i_j$:

$$(8) \qquad w_j \Delta i_j = OPT \Delta i_j - \sum_{h \neq j}^{n} w_h \Delta i_h \ .$$

Equation (8) fully describes the strategic delegation problem as N equations in N choice variables (i.e. the variables $w_1 \Delta i_1, w_2 \Delta i_2 .... w_N \Delta i_N$). Given that no two countries have the exact same median voter preferences, there can be no interior solution to this strategic delegation problem.[23]

In order to arrive at a solution, the strategic delegation problem is treated as a dynamic, finite game of perfect information with the median voters of the N countries constituting the N players, where each player has a set of pure strategies $s_j \equiv w_j \Delta i_j \in S_j$.[24] In order to rule out the case of a member state favoring a negative

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[23] The partial derivatives with respect to the "other" member states' choice variables (i.e. the "slope coefficients") are the same across member states, while the constant term $OPT \Delta i_j$ varies across member states. In a two-country framework, this corresponds to the interior part of the reaction functions in a $(w_1 \Delta i_1, w_2 \Delta i_2)$-diagram being parallel, and the two countries' reaction functions intersecting the $w_1 \Delta i_1$-axis (and the $w_2 \Delta i_2$-axis) at different points. (Note that the actual choice variable for country j is Δi_j, but since the weight w_j is fixed and assumed to be part of the common information set, the reaction function is expressed as a choice of $w_i \Delta i_j$ for convenience.)

[24] Although the delegation game is inherently of a one-shot, non-sequential nature, it is standard to assume that the players rationalize their strategies within the framework of a dynamic, sequential-move game, i.e. player j has a set of pure strategies $s_j \in S_j$, such that choosing a strategy s_j' makes it optimal for the other players to choose strategies s_h', which, in turn, makes it optimal for player j to choose strategy s_j'' instead. The revision of optimal strategies will take place until each player can do no better given the strategy of all other players, i.e. until a Nash equilibrium is reached. Since the structure of the game is assumed to be part of the information set of all players, and each player knows that this is the case, each player can do no better than immediately choosing its final strategy and no revision of strategies will occur.

end-of-current period interest rate, it is assumed that $s_j \geq s^{MIN}$, where s^{MIN} corresponds to a zero end-of-current period interest rate.

With each player's optimal monetary policy choice given and under the assumption of single-peaked preferences, the council's policy decision translates into a well-defined "player-specific" pay-off given by

(9) $$-abs(\Delta i - OPT\Delta i_j)$$

such that the smaller the deviation of the single monetary policy from player j's optimal monetary policy choice, the better off is player j.

Let λ_k denote the voter-preferences of the most weight-conservative member state, i.e. $\lambda_k = \min\{\lambda_1,...,\lambda_N\}$. Since the optimal interest rate change is strictly decreasing in median voter preferences (for each member state, respectively), $OPT\Delta i_k$ describes the most inflation-averse policy outcome preferred by any of the participating member states, i.e. $OPT\Delta i_k = \max\{OPT\Delta i_1,...,OPT\Delta i_n\}$, or, in other words, member state k prefers the highest end-of-current period interest rate.

If player k chooses a strategy such that

(10) $$w_k \Delta i_k = OPT\Delta i_k - (N-1)s^{MIN},$$

it follows that no other player j can choose a strategy such that his respective equation (8) holds with equality, since $OPT\Delta i_j < OPT\Delta i_k$ for all j. Put differently, given the strategy of player k, the resulting value of the council's monetary policy decision

already exceeds the optimal value for all players other than k. Accordingly, in order to maximize the pay-off given by equation (9), all players other than k will choose a strategy that reduces the resulting interest rate change. For all players, the strategy choice is restricted from the left (since negative interest rates are not in the feasible set of any players), thus all players other than k must choose a strategy such that

(11) $w_j \Delta i_j = s^{MIN}$ for all $j \neq k$.

The resulting set of chosen strategies

(12) $\{s^{MIN},.....,OPT\Delta i_k - (N-1)s^{MIN},....s^{MIN}\}$

constitutes a (subgame perfect) Nash equilibrium: Clearly, player k is at his optimum and could do no better. For any player other than k, deviating from the strategy given by (11) would drive the council's monetary policy choice even further away from what's preferred by the player. Accordingly, given the strategies chosen by all other players, no player would benefit from choosing a different strategy and the described equilibrium is indeed a Nash equilibrium. [25]

Since the delegation problem characterizes a finite game of perfect information with no two players having the exact same pay-off at any two terminal nodes (i.e. for choice of strategies), it follows by Zermelo's Theorem that this Nash equilibrium is also unique.[26,27]

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[25] Note that, under perfect information, allowing for non-simultaneous appointment choices will lead to the same outcome.

[26] See Mas-Colell et al. (1995) for a proof of Zermelo's Theorem.

[27] The equilibrium doesn't "explode", i.e. member state k is not choosing a delegate with preferences associated with an infinitely large end-of-current-period interest rate. The reason is simply that the preferred interest rate change is bounded from the left, since a negative nominal interest rate can be

The intuition underlying the derived corner-solution can be illustrated in a 2-country example. Suppose two countries X and Y can choose any non-negative values x and y, respectively. The preferences of both countries are single-peaked and X (Y) prefers the sum of x and y to equal, say, 10 (15). Perfect information prevails such that each country knows its own as well as the other country's preferred value. The dynamic game is then described by the two equations x + y = 10 and x + y = 15, with x,y ≥0.[28]

The first (second) equation implicitly defines the reaction function of country X (Y). Clearly, there is no interior solution. However, if X chooses 0 and Y chooses 15, neither country can improve its own – or the other country's – outcome, taking the choice of the other country as given.

The intuition for arriving at this particular solution is as follows: Y knows that X will never pick a value higher than 10 (if country X picked a value of $10+\varepsilon, \varepsilon > 0$, X could keep improving its outcome by reducing its choice until $\varepsilon = 0$, regardless of the value chosen by country Y). Therefore, Y will pick a value of at least 5. By the same logic, X will pick a value no higher than 5 and, accordingly, Y will pick a value of at least 10. If this is the case, then X must pick 0 (the value of the left hand side bound) and Y must pick 15 in order to maximize its outcome.

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ruled out a priori. The zero interest rate bound seems both economically sensible and necessary in order to avoid counterintuitive equilibria where less inflation-averse member states favor negative interest rates. The next section, however, discusses a model extension where the zero interest rate bound is not necessary for ensuring the existence of a unique equilibrium.

[28] For simplicity, the strategies in this example are bounded from the left by zero, but any (positive or negative) value strictly larger than minus infinity will yield the qualitatively same equilibrium.

The policy implication of the described equilibrium is the following: The council will implement a monetary policy identical to what the "Rogoff-central banker" of the most weight conservative member state would choose in a one-country context. As a result, monetary policy of the union will be too "tight" for the other N-1 member states.

If all member states were able to credibly delegate their respective monetary policy to a weight-conservative central banker in the absence of a monetary union, all but one country would incur a welfare loss due to the higher interest rate. However, not all N member states are likely to have entered the monetary union from a position where such credible delegation was possible. If this is true, then the relevant welfare benchmark, at least for some member states, is the inflation bias policy outcome of no delegation. Therefore, depending on the dispersion of median voter preferences across the member states, the monetary policy set by "Rogoff-central banker" of the most weight-conservative member state may well be welfare improving for other member states. By the same logic, of course, any individually credible member state would incur a welfare loss from surrendering its already optimal "Rogoff-central banker" based monetary policy to a monetary union too concerned with inflation fighting.[29]

With Germany typically viewed as the most inflation-averse member state and Bundesbank viewed as its independent monetary authority, the characterization of the

[29] This argument implicitly relies on comparisons of country-specific expected loss functions across different scenarios, i.e. delegation with or without a monetary union versus no-delegation without a monetary union.

single monetary policy as described lends support to "the twin sister hypothesis" and the idea of the ECB Council implementing the policy of the Bundesbank. This contrasts the notion of the ECB setting policy in accordance with the preferences of the "median" or "average" member state.

4. Robustness and Extensions

First, it is worth noting that the main finding of the previous section is not contingent on the loss function specification, i.e. whether an agent's output-inflation trade-off is captured by a weight on output objectives or a weight on inflation objectives and whether or not these weights sum to one. This is due to the fact that the one-country Rogoff (1985) result is immune to loss function alterations, i.e. it is optimal for the median voter of a country to delegate monetary policy to a relatively more inflation-averse authority regardless of how the median voter's (as well as the delegate's) loss function is specified. Accordingly, each member state's optimal monetary policy choice (in terms of actual inflation or in terms of interest rate decision) is loss function specification insensitive.

Second, the finding of the previous section is robust to augmenting the model to incorporate explicit inflation targets, simply because such targets would not alter the structure of the strategic delegation game. Since the interest rate must be non-negative, imposing a strictly binding target band has only two possible outcomes: 1) The target pushes the left hand side lower interest rate bound to the right but leaves the optimal strategy of the most inflation-averse member state within the target band,

in which case the outcome is exactly as described in the previous section; 2) the target creates a binding upper and lower bound in which case inflation-averse (inflation-tolerant) member states will favor an interest rate change associated with inflation at the lower (upper) bound, such that the actual inflation rate and associated interest rate change as well as what defines inflation-averse relative to inflation-tolerant will depend on the model parameters. In sum, each member state would still choose a delegate associated with either the lowest or the highest possible end-of-current period interest rate, thus an interior equilibrium would never be reached.

Third, the baseline model of the previous section assumes constant voting weight (influence) of member state j, thus allowing for an extreme delegate having the same influence as a modest delegate.[30] In order to address this concern regarding what may be interpreted as council member credibility, the constant weights are replaced by weights that are decreasing functions of the deviation from the preferences of the average (or median) council member.[31]

This extension does not qualitatively change the delegation game or the existence of a unique equilibrium. However, it makes the characterization of the equilibrium depend crucially on the dispersion of the preferences of the member

[30] For example, the delegate of the most inflation-averse member state voting for an unreasonably high interest rate change in order to off-set the votes of the less inflation-averse member states.

[31] By assuming that the influence of each council member is strictly decreasing in the deviation from the average council member position, a trade-off between optimal "misrepresentation" and loss of influence is introduced, thereby ensuring that at some point it is no longer optimal for a member state to choose an even more extreme delegate. Technically, the formalization of this model extension is straightforward and not included for brevity.

states as well as on when the marginal benefit of selecting a delegate further away from the council member mean is exactly off-set by the associated loss of influence.

Two outcomes are possible: 1) The less inflation-averse member states are restricted by either the zero interest rate bound or they reach the point where supporting further interest rate decreases would be off-set by loss of influence before (or exactly when) the most inflation-averse member state reaches a point where supporting a further anti-inflationary stance is off-set by loss of influence. This outcome replicates the result of the baseline model; 2) the most inflation-averse member state reaches the point where the effect of supporting further interest rate increases would be off-set by loss of influence before the less inflation-averse member states reach either the zero interest rate bound or the point where the effect of supporting further interest rate decreases would be off-set by loss of influence.

Although the introduced link between influence and distance from the council "consensus" ensures the existence of a unique equilibrium, this equilibrium is now qualitatively different from that of the baseline model: The monetary policy set by the council will be different and more expansionary than what is preferred by the most inflation-averse member state. Just how expansionary a policy depends on the dispersion of member state preferences and the curvature of the influence functions (weights).

In sum, the baseline results still hold when the modeling framework is expanded to address issues pertaining to council member credibility and curbing of unrealistic council member positions, as long as one or more of the following

conditions prevail: Interest rates are low, dispersion of preferences is not too wide and deviating from the average council member position does not lead to a drastic loss of influence.

Finally, it is clear that the finding of the previous section is not robust to a change in the specification of the policy instrument. For example, if the council decision making instead of focusing on interest rate changes focuses on changes in the money supply, the previous findings are reversed such that the least inflation-averse member state, in effect, gets to set the single monetary policy. The intuition follows from replacing the "natural" lower bound stemming from the necessity of non-negative interest rates by a lower bound stemming from the necessity of a non-negative money supply. With respect to the EMU, this insight seems to have more theoretical than practical relevance, however, since the actual policy instrument of the ECB is indeed interest rate changes and not money supply changes.

5. Conclusion

The paper employs a multi-country delegation model of a single monetary policy with interest rates as the actual monetary policy instrument. Rather than assuming a single policy-maker or aggregating the preferences of the council members into a union-wide loss function, each council member votes on the single monetary policy in accordance with his "nationalistic" preferences. Since the median voter theorem is indifferent to intensity of preferences such that any role for strategic delegation when the member states decide on whom to send to the council is, in effect, ruled out a

priori, an alternative and less restrictive "weighted mean mechanism" is employed. Under this mechanism, preference intensity and, therefore, strategic delegation matter and it is shown that the equilibrium of the "game" is well-defined, unique and doesn't "explode". The equilibrium is associated with a single monetary policy identical to what the most inflation-averse member state would implement in the absence of a monetary union.

This finding is seen as offering further theoretical support for "The Twin Sister Hypothesis" and the notion of the ECB implementing the policy of the Bundesbank rather than the policy of an average union-wide central bank. Furthermore, it may help explain why Germany, with a strong currency and a credibly independent monetary authority already in place, was willing to enter the EMU in the first place and it contrasts the notion of Germany forsaking a tight monetary policy in order to participate in the monetary union.

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